DETAILED FACTORS IN LATIN PROGNOSIS

DAVIS 1925

BY

ORLIE M. CLEM

SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS
FOR THE DEGREE OF DOCTOR OF PHILOSOPHY
IN THE FACULTY OF PHILOSOPHY
COLUMBIA UNIVERSITY

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O. M. C.

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DETAILED FACTORS IN LATIN PROGNOSIS

CHAPTER I

BRIEF SURVEY OF PREVIOUS STUDIES

To reduce misdirected effort is the first aim of any study in educational prognosis. The method, if it is to be other than speculative, requires an analysis of the factors which have made for success in a given situation with a view to determining the probable effect of the same factors in a second situation. Assuming that specific abilities are required in different types of learning, the problem of the investigator is to devise means for segregating and measuring these specific abilities, as a basis of prognosis. Previous to this study, four investigations have been made in the field of prognosis.

In 1914, Dr. Truman Lee Kelley[1] investigated the relative predictive value of elementary school marks, teachers' estimates, and some special tests upon the success of pupils in mathematics, history, and English, in the first year of the high school. Applying the regression equation for the first time to educational measurement, Kelley found the individual and combined prognostic values of:

1. A pupil's average in Grades 4–7.
2. The teacher's estimate of a pupil on four traits: intellectual ability, conscientiousness, emotional interest, and oral expression.
3. The scores of pupils on some special tests in school subjects.

Kelley's results showed that these instruments of prognosis should be ranked in order of importance as listed above.

Dr. Agnes Low Rogers,[2] in 1918, developed a group of six tests for predicting ability in mathematics. She ascertained that

[1] Kelley, Truman Lee: *Educational Guidance.* Teachers College, Columbia University, Contributions to Education, No. 71. New York, 1914.

[2] Rogers, Agnes Low: *Experimental Tests of Mathematical Ability and Their Prognostic Value.* Teachers College Contributions to Education, No. 89. New York, 1918.

mathematical ability was not a general trait, but was made up of a series of loosely connected capacities; that consequently no single test was an index to mathematical ability. Algebraic, geometric, and verbal abilities seemed to be of equal significance in mathematical ability.

Dr. Elbert Kirtley Fretwell,[1] in 1918, used as a basis of prognosis a group of standardized tests. He found that "academic success in the first year of the junior high school could be predicted more successfully by a group of standardized educational tests than by either elementary school marks, or teachers' estimates, or age."

In 1921–22, Dr. William Sims Allen[2] conducted an investigation entitled *A Study in Latin Prognosis.* Dr. Allen, at the beginning of the first semester, 1921–22, gave twenty-one psychological tests to three hundred sixty-four boys taking first year Latin in the Boys' High School, Brooklyn. At the end of the semester he gave to the same pupils eleven pairs of Latin tests devised by Professor Thomas H. Briggs. These tests were constructed so that they could be objectively scored and covered the eleven types of work done in the first semester of Latin. Dr. Allen, through multiple correlation procedure, chose from the twenty-one psychological tests a prognosis battery of six tests which gave the highest correlation with the eleven Latin tests used as criterion. These six tests: Briggs Analogies Tests Alpha and Beta, Thorndike Word Knowledge Tests A and B, Rogers Interpolation Tests 1 and 2, when combined gave a multiple correlation coefficient of .588. They also predicted ability as well in mathematics and English as in Latin.

[1] Fretwell, Elbert Kirtley: *A Study in Educational Prognosis.* Teachers College Contributions to Education, No. 99. New York, 1919.

[2] Allen, William Sims: *A Study in Latin Prognosis.* Teachers College Contributions to Education, No. 135. New York, 1923.

CHAPTER II

THE PROBLEM

The purpose of this study is to find the effect of certain detailed factors upon a pupil's success in first year Latin, to choose the most effective factors, and through multiple correlation to obtain their combined effect as a basis for prognosis.

Dr. Allen used one factor as a basis for prognosis,—psychological tests. The aim of the present study is to find the influence of many possible factors, including those measured by the Allen Battery of six tests. The original analysis of the problem was made on the basis of, "What are the possible factors which influence a pupil's success in first year Latin?" Obviously the original list was incomplete because no one can bottle up all the human influences affecting a pupil's Latin product. However, the original list was greatly abbreviated. Some factors were eliminated because they appeared too subtle and elusive for our present scales of measurement; others because data could not be secured, or if at all only with too great difficulty; others because they would not lend themselves to statistical treatment. Of the factors retained, it was not presumed at the outset that each had equal reliability when taken at its face value. For example, the age of a pupil is an objective measure which should be accurate. But "the average number of minutes daily" which a pupil says he spends in the preparation of Latin is a different kind of measure. Some pupils may have little ability in estimation. Some will by nature estimate too high and others too low where they themselves are concerned. Honesty with self may be an important factor. Practically every degree of reliability is represented by the various factors as shown by the correlations in the three schools studied. One of the important aims of this study is to find to what degree the various factors are reliable for different groups.

The purposes of this investigation then are:

1. To find in the groups studied the empirical effect of several detailed factors on success in first year Latin, regardless of what their reliability may subjectively appear to be.

2. To build up a battery of factors as a basis for prognosis, having consideration for the availability and objectivity of data.

CHAPTER III

DATA

1. Plan of the Experiment

This study supplements the one made by Dr. William Sims Allen, 1921–22, in the Boys' High School, Brooklyn, entitled *A Study in Latin Prognosis.* It was arranged for by the department of secondary education of Teachers College in coöperation with the classical departments of three schools of New York City: Boys' High School, Brooklyn; Wadleigh High School; De Witt Clinton High School.

2. Subjects

The subjects for this experiment consist of three groups:

Group 1. Two hundred fifteen boys in the Boys' High School, Brooklyn, who had elected to study Latin. They were the ones still remaining in school of the three hundred sixty-four used by Dr. Allen in his experiment. Dr. Allen notes that the original three hundred sixty-four were grouped in eleven classes, the groups having been made according to the pupils' scores in the Otis group test of mental ability; they were taught by four teachers. No boy had previously studied Latin. The average age was thirteen and one half years.

Group 2. Eighty-eight first year girls of the Wadleigh High School, New York City. Of the eighty-eight who took the prognosis tests at the beginning of the semester, eighty remained in school and took the Latin tests at the end of the semester. This study deals with the eighty pupils. The girls were grouped in Latin classes at Wadleigh according to the Terman group test of mental ability. From the Latin classes in the school, one class was chosen at the lower, one at the middle, and one at the upper range of ability. The average age was slightly less than fourteen years.

Group 3. One hundred ten first year boys of the De Witt Clinton High School, New York City. Of the one hundred ten who took the prognosis tests at the beginning of the semester, one hundred three remained in school and took the Latin tests at the end

of the semester. This study deals with one hundred three pupils. They were sectioned according to the Otis group test of mental ability, and the three classes used in this study were selected on the same basis as at Wadleigh. The average age was slightly more than fourteen years.

3. Factors Considered for Each Pupil

Approximately sixty separate items were considered for the three groups. They have been classified under sixteen heads called throughout this study, "Factors." Factors V, VI, and VIII were omitted from Group 1 for reasons explained later.

Factor I. Scores Made in Each Test of the Allen Prognosis Battery.[1]

The tests are:

1. Briggs Analogies Test Alpha.[2]
2. Briggs Analogies Test Beta.[2]
3. Thorndike Test of Word Knowledge A.[3]
4. Thorndike Test of Word Knowledge B.[3]
5. Rogers Interpolation Test 1.[4]
6. Rogers Interpolation Test 2.[4]

A brief description of these tests follows:

Briggs Analogies Tests Alpha and Beta consist of 72 items. They measure knowledge of form and ability to see relationship between words.

Thorndike Tests of Word Knowledge A and B consist of 100 items each. They measure the ability to recognize the meaning of words.

Rogers Interpolation Tests 1 and 2 consist of 107 items each. They measure the ability to interpolate numbers, that is, to supply omissions in a series of varied arithmetical progressions.

For the first group of pupils (215 boys, Boys' High School, Brook-

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[1] For a more complete description of these tests see: Allen, *A Study in Latin Prognosis*, p. 4.

[2] Copies of the Briggs Analogies Test may be secured from Professor Thomas H. Briggs, Teachers College, Columbia University.

[3] Copies of Thorndike Word Knowledge Tests may be secured from the Bureau of Publications, Teachers College, Columbia University.

[4] Copies of Rogers Interpolation Test may be secured from the Bureau of Publications, Teachers College, Columbia University.

lyn) the scores secured by Dr. Allen in these tests were used. The tests were scored by fifteen teachers of Boys' High School and checked by Dr. Allen.

The second group of pupils (80 girls, Wadleigh High School) were given the above tests by the writer at the opening of school, September, 1922. The papers were scored by three Latin teachers and checked by the writer.

The third group of pupils (103 boys, De Witt Clinton) were given the tests by the writer at the opening of school, September, 1922. In this group the three classes were taught by the same teacher. The papers were scored by this teacher and checked by the writer.

FACTOR II. Intelligence Quotient.

For the first and third groups the Otis group test of mental ability was used, and for the second, the Terman. Strictly speaking, the term I. Q. should apply only to the Binet-Simon scale. But the administration of the Binet-Simon scale to such a large group in an experiment of this character is impossible. Hence, in school administration the term I. Q. has come into rather common acceptance in dealing with groups of pupils measured by either of the above tests. Each test is accompanied by a table for the transmutation of raw scores into approximate I. Q.'s. It is not claimed that they are as accurate as the I. Q. of the Stanford Revision of the Binet-Simon Test.

FACTOR III. Age.

The age was secured at the beginning of the semester. The time it was taken, however, would in no way affect the correlations inasmuch as we may add, subtract, divide, or multiply a series of scores by the same constant without affecting the correlation.

FACTOR IV. High School Attendance.

The number of days attendance during the semester was used.

FACTOR V. Elementary Attendance.

The number of days attendance during the last year of the elementary school was used. This factor is lacking for Group 1.

FACTOR VI. Elementary School Marks for the Last Year, in All Subjects.

The promotion marks of both the teacher and the principal were used for the following fifteen items:

1. Reading
2. Grammar
3. Composition
4. Spelling
5. Penmanship
6. Arithmetic
7. Arithmetic
8. History and civics
9. Geography
10. Music
11. Drawing
12. Cooking (Science for Group 3)
13. Sewing (Shop for Group 3)
14. Physical training
15. General estimate

No elementary school marks were obtainable for Group 1. Promotion cards are destroyed after a year at the Boys' High School, and no duplicates are kept at many of the elementary schools.

FACTOR VII. High School Marks in All Subjects.

The semester mark for each pupil was secured in the following subjects:

GROUP 1	GROUP 2	GROUP 3
Latin	Latin	Latin
English	English	English
Mathematics	Biology	Biology
Drawing	Civics	Mathematics
Music	Drawing	Civics
Physical training	Music	Drawing
	Physical training	Music
		Physical training
		Elocution

FACTOR VIII. Ranking of Pupils by Teachers on the Following Twelve Traits:

1. Perseverance
2. Industry
3. Earnestness
4. Nerve stability
5. Orderliness
6. Self-confidence
7. Accuracy
8. Right attitude toward criticism
9. Frequency in securing help from teacher
10. Promptness and regularity in doing work
11. Ability to work independently
12. Desirable social and moral attitudes

No rankings were secured of the pupils in Group 1. Because of the possible changes in administration and instructional force, and also the lapse of time, it was thought that a ranking made after a year would be impracticable. To the teachers of Groups 2 and 3 the following blank was given:

RANKING OF PUPILS BY TEACHERS

Each teacher will please rank his or her pupils on the following points. In ranking them use this method:

1. Give those in the highest 10 per cent of the class a rank of 1.
2. Give the next 20 per cent a rank of 2.
3. Give the next 40 per cent a rank of 3.
4. Give the next 20 per cent a rank of 4.
5. Give the next 10 per cent a rank of 5.

School

Teacher

Section

Names of Pupils	Perseverance	Industry	Earnestness	Nerve Stability	Orderliness	Self-Confidence	Accuracy	Right Attitude, Criticism	Frequency in Securing Help from Teacher	Promptness and Regularity in Doing Work	Ability to Work Independently	Desirable Social and Moral Attitudes	
1.													
2.													
3.													
4.													
5.													
6.													
7.													
8.													
9.													
10.													
11.													
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37.													
38.													
39.													
40.													

It will be noted from the above blank that each teacher was asked to rank his or her pupils on the twelve traits by dividing them into five groups. Those in the upper 10 per cent were to be given a rank of 1, those in the next 20 per cent a rank of 2, those in the next 40 per cent a rank of 3, those in the next 20 per cent a rank of 4, and those in the lowest 10 per cent a rank of 5. It was thought that this method was just as accurate and not nearly so laborious as ranking each pupil in a position relative to every other.

The following set of directions was also given to each teacher. No particular merit is claimed for these directions. The ranking would possibly have been just as reliable without them. To attempt to define perseverance by the use of other words is difficult; and so it is with many of the other traits.

DIRECTIONS FOR RANKING PUPILS

Each teacher in ranking pupils will please consider the following interpretations:

PERSEVERANCE:
Ability and tendency of pupil to keep at, to continue, whatever work undertaken, regardless of difficulty or unpleasantness.

INDUSTRY:
Attention to work at hand. Pupil is alert and active in taking up new tasks and in carrying them through.

EARNESTNESS:
Pupil is serious and intent in his work; he is purposeful, determined, and eager.

NERVE STABILITY:
Nerve condition of pupil is stable and balanced. There are no disorders which harass or handicap him in his work.

ORDERLINESS:
Pupil is neat and orderly in his work.

SELF-CONFIDENCE:
The pupil believes in self, has faith in his own ability to do things.

ACCURACY:
Painstaking, careful in work; has details correct.

RIGHT ATTITUDE TOWARD CRITICISM:
Takes criticism without resentment and attempts to remedy faults.

PROMPTNESS AND REGULARITY IN DOING WORK:
Does work at the time required, and regularly.

FREQUENCY IN SECURING HELP FROM TEACHER:
Rank on number of times pupil secures help, or the amount. Do not consider the effectiveness of the help in this ranking.

ABILITY TO WORK INDEPENDENTLY:
Pupil shows initiative and originality, power to proceed alone without help from teacher or another.

Desirable Social and Moral Attitudes:

Habits and manners of pupil are such that he gets on well with his fellows and has a wholesome influence among them.

Factor IX. Study and Conditions for Study.

1. Amount of outside help on Latin and by whom given.
2. Attendance at movies.
3. Amount and character of daily sleep.

Factors IX to XVI were secured from pupils near the close of the semester by means of the questionnaire which follows:

QUESTIONNAIRE USED FOR SECURING FACTORS IX TO XVI

Name of Pupil.....
Last, First, Middle Initial

Address of Pupil.....

I. Study and Conditions for Study

1. Does anyone outside of school ever help you on Latin?.....
(Answer yes or no)

2. If so, who?.....
If father write "father"; if brother, write "brother," etc.)

3. If you do receive help, what is the average number of minutes daily?.....
(Number of minutes)

4. Estimate the number of times you go to the movies each week.....
(Give number)

5. What is the average number of hours that you sleep daily?.....
(Give to nearest hour)

6. Do you sleep about the same number of hours each night?.....
(Answer yes or no)

II. Individual Interests and Ambitions

1. Do you plan to attend high school next year?.....
(Answer yes or no)

2. Do you plan to graduate from high school.....
(Answer yes or no)

3. After high school, what do you expect to do? You will show this by placing a check before one of the following. If you are not quite sure, check the answer which seems more nearly correct.

    1. To attend college
    2. To attend teacher-training or normal school
    3. To go to trade school
    4. To go to some special school
    5. To work at home
    6. To go to work away from home

4. As your life work, what are you planning for? Place a check before one of the following. If you are not quite sure, check the one which seems more nearly correct.

1. Business
2. Trade
3. Profession
4. Home

III. Outside Work

1. Do you take music lessons outside of school?.....
(Answer yes or no)
2. If so, number of hours weekly?.....
(Give number)
3. Do you study any language or any school subject outside of school?.....
(Answer yes or no)
4. If so, what?.....Average number of hours weekly?.....
(Give number)
5. Do you work outside of school for your parents?.....
(Answer yes or no)
6. If so, what is the average number of hours that you work for them weekly?.....
(Answer to nearest hour)
7. Do you work for any person or persons besides your parents?.....
(Answer yes or no)

A. If you do work for others besides your parents, what average number of hours weekly?.....
(Give to nearest hour)

B. Name or kind of work which you do for those who are not your parents....
.....

C. How much money do you receive per week on the average for this work?
.....
(Dollars) (Cents)

IV. Study, and Rankings of Pupils

(1) Names of Subjects	(2) Study at Home	(3) Importance of Subject	(4) Preference for Subject	(5) Preference for Teacher

V. Extra-Curricular Activities

Go down the following list. Check once those activities in which you have participated. Check twice those activities in which you have held an office, during the semester.

1. General Organization
2. Athletic Association
3. Hockey
4. Basket-ball
5. Foot-ball
6. Swimming
7. Track
8. Tennis
9. Orchestra
10. Glee Club
11. Band
12. Dramatic Club
13. Debating Club
14. Literary Society
15. Poetry Club
16. Bank
17. Newspaper
18. Magazine
19. Handbook
20. Curricula Club
21. Lunch
22. Fire Drill
23. Court
24. Assembly
25. Class Officer
26. Official Section Officer
27. Roosevelt Memorial Association
28. Red Cross
29. Library
30. Honor Roll
31. Boy Scouts
32. Camp Fire Girls
33. Hi Y.

The writer, in giving the questionnaire to the pupils, explained for their protection that no teacher would be in the room during the time it was given, that the answers would be treated as confidential, and that the pupils should write what they actually believed. It is the opinion of the writer that they did this to a very great degree.

Factor X. Individual Interests and Ambitions.

The following data were secured:

1. Plan for the following year.
2. Does the pupil plan to graduate?
3. Plan after graduation.
4. Plan for life work.

Factor XI. Outside Work.

The following data were secured:

1. Amount of time given to music lessons.
2. Amount of time given to the study of any language or any school subject outside of school. It was explained here that the question meant any language or any school subject which the pupil was not then studying in school.
3. Amount of time given to work for parents outside of school.
4. Amount and kind of work done for persons besides parents with amount of money received.

Factor XII. Amount of Home Study.

Factors XII to XV were secured by means of the rectangular chart on the questionnaire. The pupils of the three schools

studied the same subjects in each respective school. The names of these subjects were written on the blackboard, and each pupil copied the list into column (1) of the chart. In column (2) he wrote opposite each subject the average amount of time spent daily on study at home. The pupils in each of the schools did no study at school, inasmuch as the schools operate on the double session basis.

Factor XIII. Importance of Subject.

Each pupil was asked to rank in column (3) the subjects listed in column (1) in "what he considered their order of importance to him." The most important was to be given a rank of 1, the next important 2, and so on.

Factor XIV. Preference of Pupil for Subject.

Using the same method as above, each pupil was asked to rank in column (4) the subjects as he liked them, regardless of their importance or any other consideration.

Factor XV. Preference of Pupil for Teacher.

Using the same method as above, each pupil was asked to rank in column (5) the teachers of the various subjects as he liked them.

Factor XVI. Participation of Pupil in Extra-Curricular Activities.

From a study of the extra-curricular activities of the three schools, an inclusive list was made of all those of any importance to which freshmen were eligible. The pupil was asked to check once those activities in which he had participated, twice those in which he had held an office, during the semester.

4. The Criterion

The criterion used in this experiment was a group of Latin tests given at the end of the semester. For Group 1, the results of Dr. Allen's experiment were used. He gave eleven Latin tests devised by Professor Thomas H. Briggs. One test was given to each of the following fields:[1]

1. Nouns
2. Vocabulary
3. Construction
4. Derivation

[1] For a more complete description of these tests, see: Allen, *A Study in Latin Prognosis*, p. 9.

5. Syllabification
6. Gender
7. Pronouns
8. Conjugation
9. Pronunciation
10. Translation from English to Latin
11. Translation from Latin to English

Each test was constructed so that it could be scored in objective units, so easy that the poorest pupil could make some score, and so difficult that the best pupil could not make a perfect score. The methods of scoring, timing, and administration were similar to those of any good standardized test.

For Groups 2 and 3 a series of ten tests, devised by the writer and paralleling those of Professor Briggs, was given. The pronoun test was omitted inasmuch as the subject had not been covered in the two texts used. Only one set of tests was given to Groups 2 and 3 owing to the high reliability of the two forms. These tests covered the materials in the texts of the two schools. In order that all pupils might more adequately be measured, the tests included only materials studied by the poorest section. It may readily be claimed that this penalizes the brightest section; yet the plan seems more desirable than to test the poorest section on materials they have never studied.

For Groups 1 the Latin tests were scored by the Latin teachers of Boys' High School, Brooklyn, and checked by Dr. Allen. For Groups 2 and 3 the papers were scored by the Latin teachers of Wadleigh and De Witt Clinton High Schools and checked by the writer.

CHAPTER IV

STATISTICAL TREATMENT

1. Tabulation and Transmutation of Raw Scores

The Criterion. For each of the three groups a combined weighted criterion score was computed for each pupil in the following manner:

In Dr. Allen's experiment, thirteen Latin teachers weighted the eleven tests.[1] The median of their weightings is shown in Table I.

TABLE I

Weights Given the Latin Criterion Tests by Thirteen Latin Teachers

Test	*Weight*
Nouns	9
Vocabulary	10
Construction	11
Derivation	6
Syllabification	5
Gender	5
Pronouns	9
Conjugation	16
Pronunciation	4
Translation from English to Latin	12
Translation from Latin to English	13

In weighting any series of tests for purposes of statistical computation, it is necessary to take account of the standard deviations of each test. Hence, the weighted score in any test is equal to the actual score divided by the standard deviation, times the weight assigned. The combined weighted criterion score of any pupil in all the tests is the sum of the weighted scores.

Let

S = the combined weighted criterion score desired for each pupil.

$B_1, B_2, B_3 \ . \ . \ . \ B_{11}$ = the weights assigned each test in the above table.

$X_1, X_2, X_3 \ . \ . \ . \ X_{11}$ = the raw scores made by a pupil in each test.

[1] Allen, *A Study in Latin Prognosis*, p. 19.

Then, the formula becomes:

$$S = B_1 \frac{X_1}{\sigma_1} + B_2 \frac{X_2}{\sigma_2} + \quad . \quad . \quad . \quad + B_{11} \frac{X_{11}}{\sigma_{11}}$$

The formula at first sight appears laborious, but in actual practice becomes rather simple.

B_1, B_2, . . . B_{11}, and σ_1, σ_2 . . . σ_{11} are constant for each test. Hence, we may write the formula:

$$S = \frac{B_1}{\sigma_1} X_1 + \frac{B_2}{\sigma_2} X_2 + \quad . \quad . \quad . \quad + \frac{B_{11}}{\sigma_{11}} X_{11}$$

So when $\frac{B^1}{\sigma_1}, \frac{B_2}{\sigma_2} \quad . \quad . \quad . \quad \frac{B_{11}}{\sigma_{11}}$ have once been obtained for each test, they may be used for every pupil within the group. The process then becomes merely one of finding for each pupil the sum of the test scores after each is multiplied by a single constant, the quotient of the B divided by the sigma. The same sigmas were used for Group 3 as for Group 2 for the following reasons:

1. The groups were of the same school grade, had been selected on the same relative intelligence basis, and were of approximately the same age.

2. Assuming that the sigmas of the different tests were slightly different in Group 3, the change in variability for all the tests would be a fairly constant ratio. Hence, the correlation of the various factors with the criterion will not be materially affected.

The combined weighted criterion scores for each pupil were next transmuted, for purposes of correlation on the chart devised by Dr. Herbert Toops. All the correlations in this study were done by the Toops' method.

The formula follows:

$$r = \frac{\frac{N}{2}[(\Sigma X^2 + \Sigma Y^2) - \Sigma(X-Y)^2] - (\Sigma X) \times (\Sigma Y)}{\sqrt{N(\Sigma X)^2 - (\Sigma X)^2}\ \sqrt{N(\Sigma Y)^2 - (\Sigma Y)^2}}$$

The chart of Dr. Toops for plotting the scatter diagram consists of eighteen steps running from 0–17, inclusive. The method of transmutation is as follows:

The lowest score made by any pupil in a group is subtracted from the highest score plus one. This gives the inclusive range. The inclusive range is then divided by 18 (the number of steps in

the chart) and the quotient represented by the next higher integer taken as the class interval. The transmutation scale is then built up. Step 1 extends from the lowest score to a number which is equal to the lowest score plus one less than the class interval. Steps 2, 3, etc., are built up in the same manner.

Tabulation and Transmutation of Factors. The same method of transmutation was used for the various items of the sixteen factors as for the criterion. The original scores of practically all items were expressed in definite numerical units so that they could be treated statistically without alteration. The following exceptions need explanation.

The elementary school marks were recorded in terms of the first letters of the alphabet. A transliteration was made on the following basis:

$$A=6,\ B+=5,\ B=4,\ C=1.$$

More involved formulae for the process are available,[1] but for practical purposes the above method is probably as reliable as any other. It is used by the Institute of Educational Research of Teachers College in its vocational guidance inquiry. A convenient scale for transmuting all the elementary marks, including the averages of two or more, extending from 10 to 60, was used.

In the case of the various rankings:

1. Ranking of pupils by teacher on 12 traits.
2. Ranking by pupil of (*a*) importance of subject; (*b*) preference for subject; (*c*) preference for teacher,

it will be recalled that 1 represented the highest score, 2 the next highest, and so on. In the statistical treatment, these values were reversed in order that the correlations might be expressed positively rather than negatively.

$$\text{Thus, } 1=7,\ 2=6,\ 3=5,\ 4=4,\ 5=3,\ 6=2,\ 7=1.$$

In the case of "plan after graduation," as shown previously, the pupil checked on the questionnaire one of six possible items:

	Score Assigned
To attend college	6
To attend teacher training or normal school	5
To go to trade school	3
To go to some special school	4
To work at home	2
To go to work away from home	1

[1] Kelley, *Educational Guidance.*

These items were ranked by a group of students of education on the basis of "academic interest" and assigned the numerical values following each item.

In the case of "plan for life" the four items:

	Score Assigned
Business	3
Trade	2
Profession	4
Home	1

were ranked in the same manner as above on the basis of "academic interest," and assigned the numerical values following each.

Inasmuch as the items of the sixteen factors were practically the same for the three groups, in building up the transmutation scales for both the criterion and the factors, a sufficiently large allowance was made in the inclusive range of the first group treated to include any probable scores in the other groups. A single exception to this is the I.Q. of Group 1, shown at the end of Table II. For Group 1, the transmuted scores of Dr. Allen were used for the criterion and the prognosis tests.

Table II shows the gross scores corresponding to steps of the Toops' chart in the combined weighted Latin criterion, and in all items of the various factors. The class interval is also given.

2. Raw Coefficients of Correlation

Table III which follows shows the raw correlation of all variables with the Latin criterion. The probable error is shown in each case.

Obviously, no correction for attenuation was made, for in the case of many factors only one measurement was or could be possible. Then, too, as Truman Lee Kelley[1] has indicated, correction for attenuation presumes an ideal relationship while the fundamental aim in any prognosis study is to obtain data as they exist and can be secured under normal conditions. Dr. Allen, in the case of some of the psychological tests, corrected for attenuation but made no use of the corrections in his study, realizing their relative unimportance from the point of view of the practical administrator.

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[1] Kelley, *Educational Guidance.*

TABLE III

SHOWING RAW COEFFICIENTS OF CORRELATION OF ALL VARIABLES WITH LATIN CRITERION

	Boys' High		Wadleigh		De Witt Clinton	
	Correlation	Probable Error	Correlation	Probable Error	Correlation	Probable Error
FACTOR I						
Prognosis Tests						
1. Briggs Analogies Alpha	.4502	.0366	.4348	.0611	.5179	.0487
2. Briggs Analogies Beta	.5314	.0330	.5034	.0563	.4721	.0517
3. Thorndike Word Knowledge A	.3488	.0404	.3001	.0686	.5123	.0490
4. Thorndike Word Knowledge B	.3357	.0408	.1772	.0730	.4765	.0514
5. Interpolation 1	.2613	.0429	.0847	.0749	.4143	.0551
6. Interpolation 2	.1452	.0450	.3440	.0665	.4231	.0546
FACTOR II						
7. Intelligence Quotient	.3568	.0401	.4778	.0582	.6118	.0416
FACTOR III						
8. Age	−.2739	.0426	−.3847	.0642	−.5659	.0452
FACTOR IV						
9. High School Attendance	−.0254	.0460	.2684	.0700	.1544	.0649
FACTOR V						
10. Elementary School Attendance.			.0832	.0749	.0704	.0662
FACTOR VI						
Elementary School Marks in All Subjects						
11. Combined Average of Elementary Reading, Grammar, Composition, and Spelling			.3307	.0672	.4107	.0553
12. Arithmetic (Average of Two Marks)			.3227	.0676	.3567	.0580
13. Combined Average of History and Civics and Geography			.2840	.0693	.2142	.0634
14. Combined Average of Penmanship, Music, and Drawing			.2188	.0718	.1814	.0643
15. Combined Cooking and Sewing Average			.3076	.0683		
A. Science alone for Group 3					.1048	.0658
B. Shop alone for Group 3					.7419	
16. Physical Training			.0955	.0747	.2353	.0628
17. General Estimate			.4368	.0610	.4254	.0545
18. Combined Average of 15 Marks Above			.4088	.0628	.3411	.0588
FACTOR VII						
High School Marks in All Subjects						
19. Semester Mark, Latin	.6241	.0281	.8371	.0226	.8332	.0203
20. Semester Mark, English	.4953	.0347	.5182	.0552	.6703	.0356
21. Semester Mark, Biology			.6964	.0388	.5506	.0463
22. Semester Mark, Mathematics	.5045	.0343			.6003	.0425
23. Semester Mark, Civics			.4030	.0632	.5443	.0468
24. Semester Mark, Drawing	.1905	.0443	.1375	.0740	.1585	.0648
25. Semester Mark, Music	.2880	.0422	.1054	.0746	.1004	.0658
26. Semester Mark, Physical Training	−.0683	.0458	.1967	.0725	.1808	.0643
27. Semester Mark, Elocution					.6348	.0397
FACTOR VIII						
Teachers' Ranking of Pupils on Twelve Traits						
28. Teacher's Ranking Perseverance			.5138	.0555	.6644	.0371
29. Teacher's Ranking Industry			.5589	.0518	.6852	.0353
30. Teacher's Ranking Earnestness			.5228	.0548	.6484	.0385
31. Teacher's Ranking Nerve Stability			.3165	.0678	.5093	.0492
32. Teacher's Ranking Orderliness			.5688	.0510	.5891	.0434
33. Teacher's Ranking Self-Confidence			.5614	.0516	.6021	.0424

TABLE III—(*Continued*)

	Boys' High		Wadleigh		De Witt Clinton	
	Correlation	Probable Error	Correlation	Probable Error	Correlation	Probable Error
34. Teacher's Ranking Accuracy			.6334	.0451	.6728	.0364
35. Teacher's Ranking Right Attitude Toward Criticism			.5472	.0528	.5411	.0470
36. Teacher's Ranking Frequency of Help			.3238	.0675	.3191	.0597
37. Teacher's Ranking Promptness			.5968	.0485	.4850	.0509
38. Teacher's Ranking Ability to Do Independent Work			.6187	.0465	.6788	.0359
39. Teacher's Ranking Social and Moral Attitudes			.4710	.0587	.5426	.0469
Factor IX						
Study and Conditions for Study						
40. Minutes of Outside Help Daily on Latin	.0132	.0460	−.0355	.0753	−.0970	.0659
41. Average Number of Movies per Week	−.0872	.0457	−.1721	.0732	−.1664	.0647
42. Average Number of Hours of Sleep Daily	−.0070	.0460	−.0585	.0751	.1249	.0655
Factor X						
Individual Interests and Ambitions						
43. Academic Interest as Shown by Plan After Graduation	−.0367	.0459	.1989	.0739	.1850	.0642
44. Academic Interest as Shown by Plan for Life	−.1727	.0446	−.1252	.0742	.0275	.0664
Factor XI						
Outside Work						
45. Time Spent Weekly Taking Music Lessons	.0323	.0460	.1770	.0730	.0880	.0660
46. Time Spent Weekly on Any Outside Language or School Subject	.0979	.0456	.1190	.0743	.1042	.0658
47. Time Spent Weekly in Work for Parents	−.0439	.0459	−.0058	.0754	−.1029	.0658
Factor XII						
Amount of Home Study						
48. Average Time Spent in Study Daily, English	.0778	.0457	−.2496	.0707	−.1456	.0651
49. Average Time Spent in Study Daily, Latin	−.1540	.0449	−.1433	.0739	−.1859	.0642
50. Average Time Spent in Study Daily, Biology			−.2424	.0710	−.0702	.0662
51. Average Time Spent in Study Daily, Mathematics	.1616	.0448			.0469	.0664
52. Average Time Spent in Study Daily, Civics	−.0598	.0458	−.2552	.0705	.1056	.0658
53. Average Time Spent, English Plus Civics, Plus Biology			−.2975	.0687	−.0515	.0663
54. Average Time Spent, English Plus Civics, Plus Biology, Plus Mathematics	.1095	.0454				
Factor XIII						
55. Pupils' Ranking of Latin on Basis of Importance	−.1014	.0455	.1603	.0735	.1397	.0652
Factor XIV						
56. Pupils' Ranking of Latin on Basis of Preference	.2705	.0426	.1416	.0739	.5154	.0488
Factor XV						
57. Pupils' Ranking of Teacher on Basis of Preference	.0984	.0456	−.0361	.0753	.3833	.0567
Factor XVI						
58. Pupils' Participation in Extra-curricular Activities	.0144	.0460	.0812	.0749	−.0374	.0664

3. Significance of Raw Correlations

Factor I. Scores Made in Each Test.

Of all the objective factors used in this experiment, Briggs Analogies tests, either Alpha or Beta, offer the best single basis of prognosis. It will be observed that the correlations for these tests in all three groups approximate .50. Of all the prognosis tests, Briggs Analogies show the greatest consistency in the three groups. Thorndike Tests of Word Knowledge have a much lower correlation and vary a great deal more. The correlations of the Rogers Interpolation Tests run fairly high with the De Witt Clinton group but are very erratic when the three groups are considered.

It will be recalled that Dr. Allen used 364 pupils, and that this study deals with 215 who were still in school the following year. It is interesting to observe the change made in the correlations by the loss of the 149 pupils from the original group. Table IV below shows Allen's correlations with 364 pupils, and the writer's correlations with the same data after 149 were dropped from the list.

TABLE IV

Showing (*a*) Allen's Original Prognosis Correlations With 364 Pupils and (*b*) Correlations of Same Data for 215 of the Same Pupils

	Allen's Correlations	Writer's Correlations
1. Briggs Analogies Alpha	.53	.4502
2. Briggs Analogies Beta	.56	.5314
3. Thorndike Word Knowledge A	.37	.3488
4. Thorndike Word Knowledge B	.38	.3357
5. Rogers Interpolation 1	.29	.2613
6. Rogers Interpolation 2	.23	.1452

The above figures show the tremendous effect of selection upon a correlation coefficient, and consequently indicate the major difficulty in an experimental investigation of this character. To obtain high coefficients of correlation it is necessary to measure heterogeneous groups. Some individuals should be of high, some of low, and some of mediocre ability. In the secondary schools, however, the pupils at the beginning of the first year are already highly selected. In the second place, Latin itself selects on some basis. Finally, and of great importance, is the fact that criterion

scores are obtained only from those who remain in school until the end of the semester. Hence, all the correlations in Table III above are much lower than they would be if we could get an exact measure of all pupils, those who drop out as well as those who remain until the end of the semester.

FACTOR II. Intelligence Quotient.

In most investigations thus far the I.Q. has a correlation with achievement in academic subjects of from .40 to .60. The lower correlations in Dr. Allen's group of 215 pupils still in school the second year would seem to indicate that the high school selects on the basis of intelligence. This is the common impression. OBrien's investigation and Book's[1] recent study in Indiana led them to disprove this common impression, yet the unpublished results of Dr. Colvin's recent study in Massachusetts disagree with Book, and substantiate the position that the high school selects on the basis of natural ability.

FACTOR III. Age.

Age seldom if ever, in grade groups, gives other than a negative correlation with academic success. Thus, the correlations with Latin in this study are typically what we should expect. The brighter pupils get into high school earlier because they are bright. The De Witt correlation of $-.57$ is unusually high. Kelley[2] found a correlation of $-.31$ between average class standing and age. Fretwell[3] found a correlation of $-.34$ between age and school marks the first year of the junior high school.

FACTORS IV AND V. High School and Elementary School Attendance.

High school attendance and elementary school attendance appear relatively unimportant factors in success in first year Latin. Although this is empirically true, few doubt the effect of long periods of absence. Long periods of absence usually mean elimination, and hence no criterion measures at all are secured. In fact, then, our empirical investigation deals for the most part only with those who have little absence. It seems fairly evident from this experiment in first year Latin, and other experiments, that if we

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[1] Book, William F.: *The Intelligence of High School Seniors.* New York, 1922.
[2] Kelley, *Educational Guidance*, p. 73.
[3] Fretwell, *A Study in Educational Prognosis*, p. 15.

use criterion measures for those pupils only who finish the semester, both elementary and high school attendance have little of prognostic value.

FACTOR VI. Elementary School Marks.

Elementary school marks have very important value as instruments of prognosis in first year Latin. Kelley and others have found similar results in the case of other academic subjects. Of the groupings of elementary subjects shown in Table III, it can be seen that the "combined average of all marks" and the "general estimate" mark are the best predictors. Of the single subjects, arithmetic and English should be given precedence. Physical training, penmanship, music, and drawing have the lowest correlations. Common experience would probably agree that Latin and these subjects have comparatively few common elements. The low correlations may also be explained in part by the fact that teachers of these subjects do not distribute the marks widely. The marks cluster around the central tendency.

From the point of view of securing very high correlations, the last mentioned difficulty plays havoc with all the elementary marks. It is a fairly rigid requirement that for a pupil to be promoted in the New York City schools, he must have a minimum mark of B. Hence, for the most part, only three marks, B, B plus, and A, are used. This practice prevents high correlations in two ways: (1) As explained above, it selects only the best pupils. (2) It places the best, when selected, within a narrow scale.

FACTOR VII. High School Marks.

High school marks for the semester, other than Latin, rank by subject in practically the same order as corresponding subjects of the elementary school. The correlations of high school marks, due to recency in time, are much higher.[1] Mathematics and English rank at the top; and drawing, music, penmanship, physical training at the bottom. Biology, .55–.70, with a correlation even higher than mathematics, would suggest that in character of content or in nature of study required, it appears to have many elements in common with Latin. The De Witt Clinton group was the only one studying elocution. The correlation, .63, is surprisingly high.

[1] Kelley: *Educational Guidance*, p. 11.

FACTOR VIII. Teachers' Rankings of Pupils.

The correlations of teachers' rankings of pupils on the twelve traits are all consistently high. Frequency of help, with .32, is the lowest. The closeness of correlation of the various traits would seem to indicate that the teachers did not distinguish closely between them, that if a pupil were given, for example, "5" on industry, the tendency was to give him "5" on all others. However, we should expect a reasonably high correlation between teachers' judgments of desirable traits.

FACTOR IX. Study and Conditions for Study.

The amount of help which a pupil receives outside of school on Latin seems in itself to be a negligible factor. Not only is the correlation negligible, but the pupils actually receive little help outside on Latin. Only 6 in Group 1, 15 in Group 2, and 14 in Group 3, report any help at all. For the Wadleigh and De Witt Clinton groups the correlations are slightly negative. These correlations are not startling for the reason that the duller a pupil, the more help he will probably need.

The correlations for the average number of movies attended per week are negative in the three groups, interestingly close in Groups 2 and 3. They would seem to justify in part the common assumption that the more movies pupils attend, the poorer they do in their work. Which is the cause and which the effect is a subject for controversy. The correlations are not large enough to be particularly significant.

The average number of hours of daily sleep, as reported by pupils, appears of little consequence. The correlations for the three groups fluctuate around 0.

FACTOR X. Individual Interests and Ambitions.

Academic interest, as shown by plan after graduation, gives positive correlations worthy of consideration for Groups 2 and 3. The correlation of Group 1 has perhaps been vitiated by the lapse of a year of time between the criterion score and the securing of the information. The lowness of the correlations is evident when the distributions are observed. Only 10 pupils in Group 1, 16 in Group 2, and 9 in Group 3, did not intend to go to college. Latin in these schools selects those who intend to go to college. The smaller proportionate number in Group 1 (to whom the question-

naire was given the second year) who do not intend to go to college, would suggest that in so far as Latin pupils are concerned, the second year of the high school selects on this basis.

The correlations for academic interest, as shown by plan for life, are not significant because of the same lack of distribution just mentioned. Only 22 in group 1, 14 in Group 2, and 8 in Group 3, did not mark "profession" as the choice for life work.

FACTOR XI. Outside Work.

The correlations for music are slightly, but not significantly, positive. This may mean that the musical pupils are the brighter, or that they are the more ambitious. Of the 398 pupils in this group, 138 took music lessons.

The suggestion above, relative to music lessons, applies equally well to the study of any language or school subject outside of school. Forty-one in Group 1, 7 in Group 2, and 15 in Group 3 pursued the study of some language or some school subject. The study of Hebrew was the most important subject pursued.

The correlations for time spent weekly in work for parents in all the groups are negative, but virtually negligible. However, the slight consistent negativeness may have important sociological implications.

No correlations were computed for the time spent on outside work for those other than parents, because too few did any outside work.

FACTOR XII. Amount of Home Study.

Most of the correlations for the time spent in study are negative. This is naturally what we should expect in subjects other than Latin: that, as pupils spend more time in other subjects, they do poorer in Latin. But the correlations for Latin itself are considerably and consistently negative. Hence, we may reasonably infer that the pupils who did poor work in Latin studied more because they were dull.

FACTOR XIII. Pupils' Ranking of Importance of Subject.

The correlations for the ranking of Latin on the basis of importance, for Schools 2 and 3, are positive, but not large. The negative correlation in the case of Group 1 is difficult to explain. The lapse of time, mentioned previously in the case of other items with this group, may be an important factor.

Factor XIV. Pupils' Ranking of Preference for Subject.

The correlations for preference of subject are fairly significant. The pupils of Group 3 were all taught by one teacher, and the high correlation of "preference for subject" and "preference for teacher" would indicate that both the subject and the teacher were popular with the pupils.

Factor XV. Pupils' Ranking of Preference for Teacher.

The correlation of ranking of teacher on basis of preference has just been commented upon in the case of Group 3. The correlations of Groups 1 and 2 would indicate that preference for teacher has negligible effect upon a pupil's success in first year Latin.

Factor XVI. Participation in Extra-Curricular Activities.

The correlations of participation in extra-curricular activities for the three groups fluctuate closely around zero. The zero correlations in this case are no doubt caused by the presence in this factor of many counter-balancing forces. For example, those pupils who are bright, who make high scores on the Latin criterion, and who are versatile in extra-curricular participation, will tend to raise the correlation. On the other hand, pupils who may be prevented from making good scores on the Latin criterion because of their diversity of extra-curricular interests, will tend to lower the correlation.

4. Effect of Detailed Factors as Shown by Multiple Ratio Correlation Coefficients, and Selection of Prognosis Factors

As set forth in the statement of the problem in Chapter II, the specific purpose of this study is, "To find the influence of certain detailed factors upon a pupil's success in first year Latin, to choose the most effective factors, and through multiple correlation to obtain their combined effect as a basis for prognosis." "A multiple correlation coefficient is that correlation which expresses the total efficiency of the scale when tests chosen are those that bear the best or highest correlation with the criterion."[1]

The contribution to a multiple correlation coefficient which any factor makes depends upon two considerations:

[1] Burr, Emily Thorp: *Psychological Tests Applied to Factory Workers*, p. 73. Doctor's dissertation, Columbia University, May 1922.

1. The correlation of the particular factor with the criterion.
2. The intercorrelation of the particular factor with other variables used.

Hence, to the investigator in prognosis, the desiderata of a good test or an effective factor are, first, that it should correlate highly with the criterion; second, that it should have a low correlation with other factors. The first is obvious. The second is evident when the meaning of a multiple coefficient is recognized. To build up a multiple coefficient for prognosis, it is necessary to measure many elements of the ability we desire to predict. Different tests or factors measure different elements to the degree that their intercorrelations are low. Empirically, two factors having an intercorrelation of plus 1.00 would measure the same elements, and have no more value than either singly.

The formula used for the multiple ratio correlation coefficients in this experiment is that of Dr. Toops:

$$r_{IC}' = \sqrt{r^2_{IC} + r^2_{IU} - 2\frac{(r_{IC} \cdot r_{IU} \cdot r_{UC})}{1 - r^2_{UC}}}.$$

The formula gives correlation coefficients slightly less than the true multiple but a very close approximation to it. It is an algebraic transmutation of some of the older formulae, designed to economize time. By the method it is possible to find the specific effect of each of a number of factors in combination, to select the most effective or desirable factors and build up a multiple ratio correlation coefficient, without computing all the intercorrelations at the beginning of the process. The total number of intercorrelations for any series of variables—n—is equal to $\frac{n(n-1)}{2}$. To compute all the intercorrelations with three groups of pupils and the number of variables used in this study would be an almost prohibitive task. By the multiple correlation ratio, the process is greatly reduced. An explanation of the terms used in the equation follows:

I = criterion.
C = combination of one test (existing at beginning of process).
C' = desired combination (formed by adding a factor to C).
U = "unique" (text or factor added).
r_{IC}' = correlation of criterion with desired combination.
r_{IC} = correlation of criterion with combination.

r_{IU} = correlation of criterion with "unique."
r_{UC} = correlation of "unique" with combination.

As stated above, the contribution of a factor to a multiple correlation coefficient depends upon its correlation with the criterion and with other factors. The formula above, when analyzed, contains only these two elements. Hence, algebraically, the effectiveness of a factor depends upon its comparative ability to function in the above formula, that is, to raise the coefficient of correlation.

Two questions arise in regard to the use of the formula. First, what is C (combination existing at the beginning of the process) and how is it secured? C, in the beginning, is the basic test to which others ("uniques") are added. The factor is selected as the basic one which has the highest correlation with the criterion. The second question is concerned with weighting. The basic test is given a weighting of 1.00. The weighting of the second test and the amount which it adds to the basic factor is found by putting the proper correlations through the $\beta \frac{U}{C}$ formula:

$$\beta \frac{U}{C} = \frac{r_{IU} - r_{IC} \cdot r_{UC}}{r_{IC} - r_{IU} \cdot r_{UC}}$$

The third test is added at weight given by the following formula:

$$\beta_1 = \sqrt{\Sigma W^2{}_y + 2\,\Sigma rxy\; Wx\; Wy}\left(\frac{r_{IU'} - r_{IC'} \cdot r_{U'C}}{r_{IC} - r_{IU'} \cdot r_{U'C}}\right)$$

By the use of the above formulae four things have been done in this experiment:

A. The Allen prognosis battery of six tests: Briggs Alpha, Briggs Beta, Thorndike A, Thorndike B, Interpolation 1, Interpolation 2, have been combined for the Wadleigh and De Witt Clinton groups.

B. The Wadleigh Group has been used as a trial group for locating and evaluating basic factors most probably significant in the three groups.

C. The four basic factors chosen in the Wadleigh group: Briggs Beta, Age, Thorndike B, and Elementary Average, are combined and the efficiency of the combination in predicting the criterion tested for each group.

D. To these four basic factors in each group other factors are added, and tested for their contribution.

A

Allen Battery Multiple Coefficients

Dr. Allen, by combining the six prognosis tests, secured with 364 pupils a multiple ratio correlation of .588. By combining the same tests for the Wadleigh and De Witt Clinton groups, coefficients of .5633 and .6673 respectively are secured. Tables IV and V give for the Wadleigh and De Witt groups the following data:

1. Correlation of each prognosis test with the criterion.
2. Intercorrelations of the prognosis tests.
3. Cumulative multiple ratio correlations of the accumulating combination (first test; first plus one added, etc).
4. Amount each test adds to the previous multiple ratio correlation coefficient.

Table IV should be read as follows: The correlation of Alpha with the criterion is .4348; its intercorrelations with the prognosis tests are: Beta .8990, Thorndike B .5829, Thorndike A .5534, Interpolation 1 .1822, Interpolation 2 .3878. The multiple ratio correlation coefficient produced by adding Alpha to Beta is .5055. The amount which Alpha contributes to Beta in combination is .0021.

TABLE IV

Showing All Tests of the Allen Prognosis Battery in Combination
Wadleigh Group

Test	Criterion (r_{1C})	Interrelations						Correlation Combination ($r_{1C'}$)	Amount Added to $r_{1C'}$
		Briggs Beta	Briggs Alpha	Thorndike B	Thorndike A	Interpolation 1	Interpolation 2		
Briggs Beta...	.5034		.8990	.6014	.6160	.2155	.3942	.5034	
Briggs Alpha..	.4348	.8990		.5829	.5534	.1822	.3878	.5055	.0021
Thorndike B..	.1772	.6014	.5829		.9128	.0950	.2451	.5270	.0215
Thorndike A..	.3001	.6160	.5534	.9128		.0982	.2564	.5367	.0097
Interp. 1.....	.0847	.2155	.1822	.0950	.0982		.6263	.5377	.0010
Interp. 2.....	.3440	.3942	.3878	.2451	.2564	.6263		.5634	.0257

It will be observed from Tables IV and V that the correlation .588 of Allen's prognosis battery with the criterion is approximately midway between the Wadleigh correlation .5634 and the De Witt Clinton correlation .6672. This would seem to indicate

that with different groups of pupils the Allen prognosis battery of tests assures a valid prediction of approximately .60 with the criterion.

TABLE V

SHOWING ALL TESTS OF THE ALLEN PROGNOSIS BATTERY IN COMBINATION DE WITT CLINTON GROUP

Test	Criterion (r_{1C})	Intercorrelations						Correlation Combination ($r_{1C'}$)	Amount Added to $r_{1C'}$
		Briggs Beta	Briggs Alpha	Thorndike B	Thorndike A	Interpolation 1	Interpolation 2		
Briggs Beta...	.4721		.8640	.2873	.2453	.4041	.4412	.4721	
Briggs Alpha..	.5179	.8640		.3153	.2879	.4391	.4587	.5202	.0481
Thorndike B..	.4765	.2873	.3153		.8205	.1159	.1973	.6154	.0952
Thorndike A..	.5123	.2453	.2879	.8205		.2007	.2670	.6325	.0171
Interp. 1.....	.4143	.4041	.4391	.1159	.2007		.8043	.6669	.0344
Interp. 2.....	.4231	.4412	.4587	.1973	.2670	.8043		.6672	.0003

B

SELECTION OF "BASIC FACTOR COMBINATION" FROM WADLEIGH GROUP

The checking of Allen's experiment and the validity of the prognosis tests is an important outcome of this study. But it is only one phase of the main problem. "The aim of the present study is to find the influence of many possible factors including the Allen battery of six tests." From the beginning of this study, two types of factors were recognized: first, those of a purely predictive value, i. e., factors for which data could be secured for any pupil before he began the study of Latin; second, those factors which affect a pupil's Latin product. In general, the first type of factor tells what capacities a pupil should have in order to succeed, and may be thought of as "effective" factors. The second type of factor shows the influence of specific conditions upon the achievement of a pupil of given capacity, during his study of Latin, and may be designated as "affective" factors. The procedure in this experiment has been to give first consideration to those factors of a purely predictive character; second, to add "affective" or relational factors.

The Wadleigh group was used as a trial group for locating and evaluating basic factors most probably significant in the three groups. Of the items considered in the experiment, the following

17 belong to the predictive type. Of these 17, Briggs Beta showed the highest correlation with the criterion, .5034. Hence, it was taken as the basic factor. Each of the other 16 items was then combined and tested for contributions, with Briggs Beta. The results are shown in Table VI following. Table VI should be read as follows: The correlation of Alpha with the criterion is .4348, with Beta .8990. The correlation produced by adding Alpha to Beta is .5055. The amount which Alpha adds to Beta is .0021.

TABLE VI

SHOWING TESTING OF 16 PREDICTIVE FACTORS FOR ADDITION TO BRIGGS BETA
WADLEIGH GROUP

	(r_{IU})	r_U(Beta)	$(r_{IC'})$	Amount added to Beta .5034
Alpha	.4348	.8990	.5055	.0021
Thorndike A	.3001	.6160	.5037	.0003
Thorndike B	.1772	.6014	.5318	.0284
Interpolation 1	.0847	.2155	.5040	.0006
Interpolation 2	.3440	.3942	.5277	.0243
I. Q.	.4778	.6071	.5481	.0447
Elementary Attendance	.0832	.0689	.5057	.0023
Av. (R, G, C, S)	.3307	.4549	.5061	.0027
Arithmetic	.3227	.3417	.5283	.0249
Av. (H, C) and G	.2840	.3376	.5179	.0145
Av. (P, M, Dr.)	.2188	.1033	.5306	.0272
Av. (S and C)	.3076	.3053	.5288	.0254
Physical Training	.0955	.2639	.5048	.0014
General Estimate	.4368	.4551	.5549	.0515
Elementary Average	.4088	.4451	.5440	.0406
Age	−.3847	−.0798	.6107*	.1073*

From Table VI we observe that age makes by far the most effective contribution, raising Beta from .5034 to .6107. Briggs Alpha adds practically nothing when Beta is in the combination. The same relation exists between the two forms of the Thorndike tests, as shown throughout this experiment. The two forms of each pair have a high self-correlation. Allen, with one from each of the three pairs of the prognosis tests in combination, secured with the criterion a correlation of .578, practically as high as with all six tests.

General estimate, which is a rating of the elementary teacher and principal, ranks second, with I.Q. and elementary average a

close third. Elementary attendance is relatively unimportant as would be expected from the low criterion correlation. Arithmetic makes the greatest contribution among the academic subjects. The non-academic subjects in the combination seem more effective than the academic. The reason will be suggested later.

Age was next placed in the combination, and the remaining 15 items tested for inclusion as the third factor. Table VII shows the results.

TABLE VII

Showing Testing of 15 Predictive Factors for Addition to Combination (Briggs Beta and Age)

Wadleigh Group

	r_{U}(Age)	($r_{IC'}$)	Amount added to Briggs Beta and Age, .6107
Alpha	—.1108	.6129	.0022
Thorndike A	—.0515	.6110	.0003
Thorndike B	—.0212	.6249	.0142
Interpolation 1	—.0637	.6121	.0014
Interpolation 2	—.2209	.6170	.0063
I. Q.	—.5708	.6110	.0003
Elementary Attendance	—.0004	.6128	.0021
Av. (R, G, C, S)	—.2537	.6115	.0008
Arithmetic	—.2341	.6168	.0061
Av. (H, C, G)	—.1490	.6155	.0048
Av. (P, M, Dr.)	—.0042	.6336	.0229
Av. (S and C)	.0827	.6410*	.0303*
Physical Training	—.0723	.6134	.0027
General Estimate	—.2796	.6275	.0168
Elementary Average	—.1622	.6306	.0199

Inasmuch as age enters into the I.Q., it appears that when age is in the combination, I.Q. ceases to function. On first, but not second thought, it would seem startling that the sewing and cooking average stands first in the above table. "If you wish to predict a pupil's success in first year Latin, secure her elementary sewing and cooking marks" would appear humorous to most Latin professors. Why does sewing and cooking come out ahead of, for example, arithmetic, or average (R, G, C, S)? It is evidently because of its low intercorrelation with Briggs Beta. These last-named subjects, as shown by the criterion correlations, page 31, have more in common with Latin than sewing and cooking do, but they also have more in common with Briggs Beta. Hence, when

Briggs Beta is already in the combination, sewing and cooking make the greater contribution. Elementary average stands second, with Thorndike B a negligible amount less.

Thorndike B was next placed in the combination. It was given precedence over sewing and cooking because of the less objective nature of these marks; also, incidentally, because the other two groups did not have sewing and cooking. It is probably more objective than elementary school average, and requires less labor. Table VIII shows the results.

TABLE VIII

SHOWING TESTING OF 14 PREDICTIVE FACTORS FOR ADDITION TO COMBINATION (BRIGGS BETA, AGE, THORNDIKE B)

WADLEIGH GROUP

	r_U(Thorndike B)	$(r_{IC'})$	Amount added to Briggs Beta, Age, Thorndike B, .6249
Briggs Alpha	.5829	.6249	.0000
Thorndike A	.9128	.6322	.0073
Interpolation 1	.0950	.6263	.0014
Interpolation 2	.2451	.6318	.0069
I. Q.	.7219	.6276	.0027
Elementary Attendance	.0304	.6270	.0021
Av. (R, G, C, S)	.3606	.6269	.0020
Arithmetic	.1527	.6299	.0050
Av. (H, C, G)	.3361	.6332	.0083
Av. (P, M, Dr.)	.0560	.6479	.0230
Av. (S and C)	.2509	.6618*	.0369*
Physical Training	.2571	.6259	.0010
General Estimate	.4330	.6477	.0228
Elementary Average	.3278	.6484	.0235

With the exception of sewing and cooking, elementary average with a correlation of .6484 stands highest. The other items remain in about the same relative position as in the preceding tables.

From an examination of the multiple ratio correlations of the foregoing tables, it is evident that the four most objective and most consistently outstanding factors are: Briggs Beta, Age, Thorndike B, and Elementary Average. They should go into the combination in this order; yet the results would be probably not far different, no matter in which order they were combined. An examination of the criterion correlations of these four factors for the Boys High and De Witt groups indicates, by and large, a close

correspondence. Allowing for certain evident reasons for discrepancy (such as the lowering of the Boys High correlations by the selection of those still in school at the end of the third semester) we should expect from the four factors comparable multiple ratio coefficients. The procedure follows in Section C.

For purely experimental reasons, however, it was decided in the case of the Wadleigh group to add to Briggs Beta, Age, and Thorndike B (giving sewing and cooking precedence over Elementary Average) three more of the original 17 items, solely on the basis of the amount they would add to the highest multiple ratio correlation coefficients. The three items proved to be: Average (sewing and cooking), Physical training, Average (penmanship, music, and drawing). Tables IX, X, and XI show the results.

TABLE IX

Showing Testing of 13 Predictive Factors for Addition to Combination Briggs Beta, Age, Thorndike B, Average (Sewing and Cooking) Wadleigh Group

	r_U(Sewing and Cooking)	$(r_{IC'})$	Amount added to Briggs Beta, Age, Thorndike B, Sewing and Cooking, .6618
Briggs Alpha	.2030	.6626	.0008
Thorndike A	.3020	.6629	.0011
Interpolation 1	−.0148	.6626	.0008
Interpolation 2	.1268	.6663	.0045
I. Q.	.1754	.6629	.0011
Elementary Attendance	.3461	.6622	.0004
Av. (R, G, C, S)	.4938	.6646	.0028
Arithmetic	.1582	.6642	.0024
Av. (H, C, G)	.5394	.6620	.0002
Av. (P, M, Dr.)	.4699	.6657	.0039
Physical Training	.4523	.6754*	.0136*
General Estimate	.5232	.6648	.0030
Elementary Average	.6918	.6622	.0004

When the remaining items are tested for their contributions to the combination: Briggs Beta, Age, Thorndike B, (Sewing and Cooking), Physical Training, (Penmanship, Music, and Drawing), none of them make contributions worthy of consideration. General Estimate, .6903, which stands highest, adds only .0029. It might be possible by placing a few more factors in the combination to raise .6903 to .70 or more, but the effort as shown by the above

TABLE X

Showing Testing of 12 Predictive Factors for Addition to Combination Briggs Beta, Age, Thorndike B, Sewing and Cooking, Physical Training

Wadleigh Group

	r_{U}(Physical Training)	$(r_{IC'})$	Amount added to Briggs Beta, Age, Thorndike B, Sewing and Cooking, Physical Training, .6754
Briggs Alpha	.2095	.6764	.0010
Thorndike A	.2164	.6773	.0019
Interpolation 1	.1643	.6756	.0002
Interpolation 2	.0322	.6782	.0028
I. Q.	.1303	.6756	.0002
Elementary Attendance	.3019	.6755	.0001
Av. (R, G, C, S)	.5099	.6754	.0000
Arithmetic	.2621	.6796	.0042
Av. (H, C, G)	.4485	.6763	.0009
Av. (P. M. Dr.)	.4758	.6874*	.0020*
General Estimate	.5564	.6857	.0003
Elementary Average	.6749	.6827	.0073

TABLE XI

Showing Testing of 11 Predictive Factors for Addition to Combination Briggs Beta, Age, Thorndike B, (Sewing and Cooking), Physical Training, (Penmanship, Music, Drawing)

Wadleigh Group

	r_{U}(Penmanship, Music, Drawing)	$(r_{IC'})$	Amount added to Briggs Beta, Age, Thorndike B, Sewing and Cooking Physical Training, (Penmanship, Music, Drawing) .6874
Briggs Alpha	.0401	.6877	.0003
Thorndike A	.0680	.6891	.0017
Interpolation 1	.0473	.6877	.0003
Interpolation 2	.0703	.6899	.0025
I. Q.	—.0019	.6882	.0008
Elementary Attendance	.2086	.6875	.0001
Av. (R, G, C, S)	.3886	.6896	.0022
Arithmetic	.2512	.6890	.0016
Av. (H, C, G)	.3548	.6875	.0001
General Estimate	.4566	.6903*	.0029*
Elementary Average	.6082	.6877	.0003

experimental procedure would not be justified. The accretions are too small and, as previously stated, the data are not sufficiently objective for a prognosis scale. A correlation of .69 is the correlation with the Latin criterion, secured in the case of the Wadleigh group, when factors are selected regardless of objectivity, solely on the basis of how much they will add.

C

Testing of Four Basic Factor Combination for Each Group

The four basic factors selected in the Wadleigh group: Briggs Beta, Age, Thorndike B, and Elementary Average, were placed in the combination and tested for each of the other groups. Table XII shows the intercorrelations of the four factors for the three groups.

TABLE XII

Showing Intercorrelations of Four Basic Factors for the Three Groups

	Boys High			Wadleigh				De Witt Clinton			
	Beta	Age	Thorndike B	Beta	Age	Thorndike B	Elem. Av.	Beta	Age	Thorndike B	Elem. Av.
Briggs Beta.		−.2772	.3931		−.0798	.6014	.4451		−.2482	.2873	.1922
Age.....	−.2772		−.1225	−.0798		−.0212	−.1622	−.2482		−.2922	−.1865
Thorndike B.	.3931	−.1225		.6014	−.0212		.3278	.2873	−.2922		.2514
Elem. Average.....				.4451	−.1622	.3278		−.1922	−.1865	.2514	

Table XIII shows the multiple ratio coefficients when one, two, three, and four of the factors are in the combination. The accretions to the previous coefficients are also shown.

We note from Table XIII that the four basic factor combination gives for the De Witt Clinton group a coefficient of .7227; for the Wadleigh, .6484; and for Boys High, .5639. The coefficients in the case of the De Witt Clinton group, as various factors are added, run considerably higher than in the case of the Wadleigh. In the De Witt group, Age, with a criterion correlation of −.57, makes a tremendous contribution. The Boys High correlations run considerably lower for reasons that have been explained. We have selected from Allen's group those pupils still in school at the end of the third semester. By this selection, as seen on page 21, the

TABLE XIII

SHOWING MULTIPLE COEFFICIENTS FOR THREE GROUPS WITH FOUR BASIC FACTORS IN THE COMBINATION

	BOYS HIGH		WADLEIGH		DE WITT CLINTON	
	r_{1C}'	Amount Added to r_{1C}'	r_{1C}'	Amount Added to r_{1C}'	r_{1C}'	Amount Added to r_{1C}'
Briggs Beta alone	.5314		.5034		.4721	
Briggs Beta, Age	.5475	.0161	.6107	.1073	.6614	.1893
Briggs Beta, Age, Thorndike B	.5639	.0164	.6249	.0142	.7080	.0466
Briggs Beta, Age, Thorndike B, and Elementary Average			.6484	.0235	.7227	.0147

criterion correlation of Briggs Beta has fallen from .56 to .53; Thorndike B, from .38 to .34. Also, due largely to this selection, the correlation of Age with the criterion in this group runs considerably lower. No elementary marks were obtained for this group. Had scores in the four basic factors for all of Allen's pupils been secured, the results for this group would no doubt approximate those of the other two.

D

ADDITION OF OTHER FACTORS TO THE FOUR BASIC FACTOR COMBINATION

It should be clear from the preceding pages that the application of the Toops' multiple ratio correlation formula makes it possible to construct norms at different levels. If we give one test or use one factor, we obtain a certain multiple ratio correlation. The addition of another test or factor gives a higher correlation, and so on. The significance of different correlations will be indicated in the next chapter. To be practical administratively, the amount a test or factor adds must justify the extra effort required.

It was decided to add the other factors in the experiment to the "four basic factor combination." From a practical point of view it was not necessary to go through the statistical computation for every individual item. For example, the correlations of the twelve

traits with the criterion run close together. Having the contribution of one to the multiple correlation ratio, we can estimate fairly closely the contribution of another. Thus, the foregoing data in this experiment made it possible to abbreviate somewhat the complete list of items in the following ways:

1. The elementary school average showed consistently with the criterion and in the combination approximately as high a correlation as any elementary school mark. Being an average, it is more reliable than any of them. Hence, elementary average was the only item used for the elementary marks.

2. English and mathematics showed the highest consistent correlation with the criterion of any of the high school marks. So the average of the English and mathematics marks was used as a single item from the list of high school marks. The Wadleigh group did not have mathematics; so English alone was used.

3. The correlations of the twelve traits run close together for each group. Two items were placed in the combination: (*a*) Accuracy. (*b*) Sum or composite score on all traits except "frequency of help."

4. From the factor, "time spent on study," two items were selected: (*a*) Time spent on Latin. (*b*) Combined time spent on other subjects.

By the above plan the original list was reduced to 24 items exclusive of the "four basic factors." Tables XIV and XV, following, show respectively for the Wadleigh and De Witt Clinton groups the following data:

1. Intercorrelations of the 24 items with each of the four basic factors.
2. Multiple ratio coefficients.
3. Amount each factor adds to the four basic factor combination.

Tables XIV and XV show that in each of the two groups only three items make any significant contributions, when tested with the four basic factor combination. These three factors are: (English and mathematics), accuracy, sum of traits. They add in the case of each group as follows:

	Wadleigh	*De Witt Clinton*
(English and Mathematics)	.04	.07
Accuracy	.14	.08
Sum of Traits	.16	.10

TABLE XIV

SHOWING TESTING OF 24 ITEMS WITH "FOUR BASIC FACTOR COMBINATION"
WADLEIGH GROUP

	Intercorrelation				(r_{IC}')	Amount Added
	Briggs Beta	Age	Thorndike B	Elem. Av.		
1. Briggs Alpha	.8990	−.1108	.5829	.3744	.6488	.0004
2. Thorndike A	.6160	−.0515	.9128	.3759	.6502	.0018
3. Interpolation 1	.2155	.0637	.0950	.1770	.6512	.0028
4. Interpolation 2	.3942	−.2209	.2451	.2128	.6538	.0054
5. I. Q.	.6071	−.5708	.7219	.3653	.6495	.0011
6. High School Attendance	.0950	−.1691	−.0295	.0851	.6653	.0169
7. Elementary Attendance	.0689	−.0004	.0304	.3560	.6485	.0001
8. Av. (English & Mathematics)	.6367	−.1329	.6670	.3387	.6876	.0392
9. Accuracy	.1281	−.2810	−.0071	.2911	.7870	.1386
10. Sum of Traits	.1876	−.2974	.0424	.3265	.8049*	.1565*
11. Minutes of Help	−.0671	−.1218	−.1397	.0028	.6516	.0032
12. Movies	.0548	.0809	−.0811	−.0670	.6699	.0215
13. Sleep	.0774	−.0418	.1164	−.0498	.6538	.0054
14. Plan after Graduation	.0646	−.2628	.0626	.1047	.6521	.0037
15. Plan for Life	.0205	−.0238	−.0034	.0199	.6649	.0165
16. Music Lessons	.0416	−.1942	−.0504	.1246	.6514	.0030
17. Outside Language	.0080	−.0973	−.0449	−.0217	.6534	.0050
18. Work for Parents	−.0750	.2049	.0823	−.0285	.6589	.0105
19. Time Spent, Latin	.0687	.1145	.2266	.0159	.6575	.0091
20. Time Spent, Other Subjects	−.3106	.2101	−.2865	−.1762	.6547	.0063
21. Importance of Subject	−.0876	−.0225	−.0369	.2876	.6622	.0138
22. Preference for Subject	−.2993	−.1965	−.5116	.0037	.6646	.0162
23. Preference for Teacher	.3954	−.0558	−.6521	−.1954	.7209	.0725
24. Extra-Curricular	.1473	−.0019	.2154	.1296	.6486	.0002

TABLE XV

SHOWING TESTING OF 24 ITEMS WITH "FOUR BASIC FACTOR COMBINATION"
DE WITT CLINTON GROUP

	Intercorrelation				(r_{IC}')	Amount Added
	Briggs Beta	Age	Thorndike B	Elem. Av.		
1. Briggs Alpha	.8640	−.3077	.3153	.1650	.7257	.0030
2. Thorndike A	.2453	−.3449	.8205	.1963	.7286	.0059
3. Interpolation 1	.4041	−.3452	.1159	.1226	.7346	.0019
4. Interpolation 2	.4412	−.3215	.1973	.2331	.7299	.0072
5. I. Q.	.4401	−.6603	.6476	.3137	.7238	.0011
6. High School Attendance	.1815	.0311	−.1082	.0236	.7359	.0132
7. Elementary Attendance	−.0063	−.0496	−.1250	−.0228	.7281	.0054
8. Av. (English & Mathematics)	.4518	−.4346	.3137	.4461	.7897	.0670
9. Accuracy	.2833	−.5172	.1923	.3010	.8034	.0807
10. Sum of Traits	.2873	−.4589	.1738	.2749	.8239*	.1012*
11. Minutes of Help	−.1631	.0964	.0302	.0015	.7230	.0003
12. Movies	−.1163	.0740	−.1276	−.0266	.7260	.0033
13. Sleep	.0335	−.2194	.1451	−.0124	.7228	.0001
14. Plan after Graduation	.2350	−.1250	.1161	.0351	.7236	.0009
15. Plan for Life	.0899	−.2141	−.0088	.0159	.7279	.0052
16. Music Lessons	.1155	−.1381	−.0037	−.0407	.7227	.0000
17. Outside Language	−.0006	−.1006	−.0170	−.1836	.7294	.0067
18. Work for Parents	.0276	.1442	−.1633	.0007	.7228	.0001
19. Time Spent, Latin	−.1319	.1061	−.1882	−.0670	.7245	.0018
20. Time Spent, Other Subjects	−.0865	.0934	−.1946	−.1441	.7273	.0046
21. Importance of Subject	−.0434	−.1038	.1091	.2124	.7246	.0019
22. Preference for Subject	.2453	−.3968	.2277	.2596	.7553	.0326
23. Preference for Teacher	.2219	−.2401	.3741	.1448	.7327	.0100
24. Extra-Curricular	.0384	.0089	.0739	.1381	.7277	.0050

Preference for teacher adds .07 in the case of Wadleigh, but only .01 in the case of De Witt Clinton. Preference for subject adds .02 and .03, respectively, for the two groups. Movies, and academic interest as shown by plan for life work, each adds .02 in the case of Wadleigh, but neither factor makes any contribution to De Witt Clinton. The contributions of all other factors are insignificant.

Inasmuch as (English and mathematics), accuracy, and sum of traits do not belong to the purely predictive class of factors, Tables XIV and XV verify the fact that, for predictive purposes, the four basic factor combination is in all probability the best combination.

Sum of traits, which includes accuracy, makes a greater contribution than accuracy alone. Both accuracy and sum of traits make a greater respective contribution than (English and mathematics). Hence, it was decided to retain sum of traits in combination with the four basic factors and to add (English and mathematics). With five factors in the combination: Briggs Beta, Age, Thorndike B, Elementary Average, Sum of Traits, the multiple ratio coefficients are .8049 and .8239, respectively, for Wadleigh and De Witt Clinton. Adding English to Wadleigh and (English and mathematics) to De Witt Clinton, the coefficients become .8241 and .8400, respectively. These two multiple ratio coefficients, with six factors in the combination: Briggs Beta, Age, Thorndike B, Elementary Average, Sum of Traits, (English and mathematics), are the highest accumulated correlation coefficients obtained in this experiment. They were obtained by sifting the data of the sixty items of the experiment for elements in common or indicative of success in first year Latin, as measured by the Latin criterion tests used in the experiment. As stated previously, four of these items belong to the purely predictive type: Briggs Beta, Age, Thorndike B, Elementary Average. The fifth factor, Sum of Traits, is "affective"; the sixth, (English and mathematics), is predictive in the event that first year Latin be not commenced until the second semester. Otherwise, it is affective or relational.

It will be recalled that, in the case of the Boys High group, elementary average and sum of traits are lacking. Thus, we have for this group only four of the six factors selected above, and only three of the four basic factor combination. An examination of

the low criterion correlations of many items of this group shows a close correspondence with the criterion correlations of the other two groups. Reference to Tables XIV and XV shows that such low criterion correlations can make no significant contribution, and that the testing of them is a waste of time. It was decided, therefore, to test the following eight items with three basic factors in the combination. The results are shown in Table XVI.

TABLE XVI

SHOWING TESTING OF 8 ITEMS WITH THREE BASIC FACTORS IN THE COMBINATION

BOYS HIGH GROUP

	Intercorrelation			$(r_{IC'})$	Amount Added to $r_{IC'}$ .5639
	Briggs Beta	Age	Thorndike B		
High School Attendance	−.0515	−.0274	−.0577	.5639	.0000
English and Mathematics	.5037	−.2503	.4347	.6558*	.0919*
Preference for Teacher	−.0448	.0615	−.0237	.5786	.0147
Thorndike A	.3752	−.1320	.8072	.5669	.0030
Interpolation 1	.3194	−.1932	.3070	.5667	.0028
Interpolation 2	.1994	−.1887	.1710	.5640	.0001
Briggs Alpha	.8203	−.2255	.3987	.5640	.0001
I. Q.	.4848	−.2143	.5809	.5652	.0013

(English and mathematics) gives a correlation coefficient of .6558 when added to the combination. It contributes .09, practically the same as in the case of the other two groups. Preference for teacher adds .01. The other additions are even more trivial. For this group, in which only four of the six factors used in the other two groups are available, the highest correlation coefficient obtained is .6558.

CHAPTER V

PRACTICAL IMPLICATIONS

In this experiment, multiple ratio correlation coefficients have been secured for the following combinations:

1. The four basic factor combination: Briggs Beta, Age, Thorndike B, Elementary Average.
2. The six factor combination: Briggs Beta, Age, Thorndike B, Elementary Average, Sum of Traits, Average (English and Mathematics).
3. The Allen Prognosis Battery: Briggs Analogies Tests, Alpha and Beta; Thorndike Word Knowledge Tests A and B; Rogers Interpolation Tests 1 and 2.
4. The Allen Prognosis Battery plus Age and Elementary Average.[1]
5. The seven factor combination for the Wadleigh group: Briggs Beta; Age; Thorndike B; Sewing and Cooking; Physical Training; Penmanship, Music, and Drawing; General Estimate.

TABLE XVII

Showing Multiple Ratio Coefficients of All Combinations for Three Groups

	Boys High	Wadleigh	De Witt Clinton
1. Four Basic Factor Combination...	.5639[a]	.6484	.7227
2. Six Factor Combination.....	.6558[b]	.8241	.8400
3. Allen Prognosis Battery.....		.5634	.6672
4. Allen Prognosis Battery plus Age and Elementary Average.....		.6582	.7474
5. Seven Factor Combination for the Wadleigh Group.....		.6903	

[a] Elementary average lacking. [b] Elementary average and sum of traits lacking.

Table XVII shows the correlation coefficients obtained for these combinations with the three groups. Only three factors of the four factor combination are present for the Boys High group:

[1] Age alone raises Allen Battery to .6419 and .7324 for Wadleigh and De Witt Clinton, respectively.

Briggs Beta, Age, Thorndike B. Only four factors of the six factor combination are present for the same group: Briggs Beta; Age; Thorndike B; Average of English and Mathematics.

In the practical interpretation of the above coefficients, two questions suggest themselves:

First, in terms of the data of this experiment, what do the correlation coefficients for these five combinations represent?

1. The first combination consists of four predictive factors, that is, factors for which objective data may be secured before the pupil begins the study of Latin.
2. The second combination consists of four predictive factors, a fifth which is "affective," and a sixth which is predictive in the event that first year Latin be not commenced until the second semester. This combination shows the achieve ment of pupils of a given age and capacity who in the judgment of the individual teacher possess certain traits of character and of industry.
3. The third combination is predictive and consists of six objective factors.
4. The fourth combination consists of eight objective factors, all of which are predictive.
5. The fifth combination consists of three objective factors and four of a less objective nature.

The second question which suggests itself is, "What do these correlations mean? How are they to be interpreted?"

No one can tell with absolute accuracy just what a coefficient of correlation means. Professor Edward L. Thorndike in Tables XVIII and XIX, which are used here with his permission, has given the best approximation. Table XVIII shows when the correlation of any factor or combination is .60, that 39.2 per cent of the first tenth will be placed in the first tenth, 20.4 per cent of the second tenth will be placed in the second tenth, 13.7 per cent of the third tenth in the third tenth, and so on. Table XIX shows the distribution of successive tenths of the group when the correlation is .80. In this case, 56.2 per cent of the first tenth will be placed in the first tenth, 23.1 per cent of the second tenth in the second tenth, and so on.

Of all the correlations in Table XVII, Figures 1 to 4, with the discussion which follows, illustrate the significance of four specific

correlations. They range from .5634 to .84. Figure 1 shows for the Wadleigh group the distribution of pupils on the Allen Prognosis Battery and the Latin criterion, correlation .5634. Figure 2 shows for the Wadleigh group the distribution of pupils on the six factor combination and the Latin criterion, correlation .8241. Figure 3 shows the distribution of pupils for De Witt Clinton on the Allen Battery and the Latin criterion, correlation .6672. Figure 4 shows the distribution of pupils for the De Witt Clinton group on the six factor combination and the Latin criterion, correlation .84. The composite score of pupils in each of the above combinations was found by the method explained on page 16. The constant quotients were obtained by dividing the true weight of a factor by its sigma.

By a careful examination of Figures 1 to 4 in relation to pupil achievement, as measured by the teacher's mark at the end of the semester, the following facts are revealed.

A

Wadleigh Group

On Figs. 1–4 the circles indicate the pupils who failed Latin. Of the 80 pupils, 11 or 13.75 per cent failed Latin for the semester, the passing mark being 60 per cent. Although the criterion was not used as final examination, 100 per cent of the failures were below the average on the criterion; 81.8 per cent were below the average on the Allen Battery. If we choose some arbitrary score, such as 8 on Figure 1, we find that 54.5 per cent of the failures and four pupils who passed are below 8. The average mark of these four is 81.25 per cent; 63.6 per cent of failures and nine who passed fall below 9 on the Allen Battery. The average mark of those who passed was 78 per cent.

On the six factor combination (Figure 2), 18.2 per cent of the failures and no one who passed fall below 3; 27.3 per cent of the failures and no one who passed fall below 4; 72.7 per cent of the failures fall below 5, that is, in the lowest decile, with no one who passed included.

B

De Witt Clinton Group

In the case of the Allen Battery, 20 per cent of the failures and seven pupils passed by the faculty are below 8. The average

FIGURE 1. SHOWING DISTRIBUTION OF WADLEIGH GROUP ON ALLEN PROGNOSIS BATTERY AND THE LATIN CRITERION

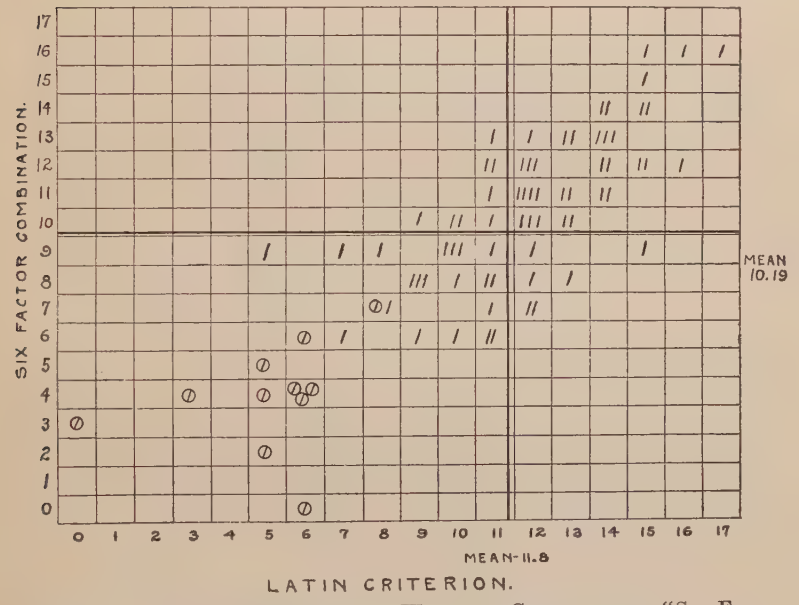

FIGURE 2. SHOWING DISTRIBUTION OF WADLEIGH GROUP ON THE "SIX FACTOR COMBINATION" AND THE LATIN CRITERION

FIGURE 3. SHOWING DISTRIBUTION OF DE WITT CLINTON GROUP ON ALLEN PROGNOSIS BATTERY AND THE LATIN CRITERION

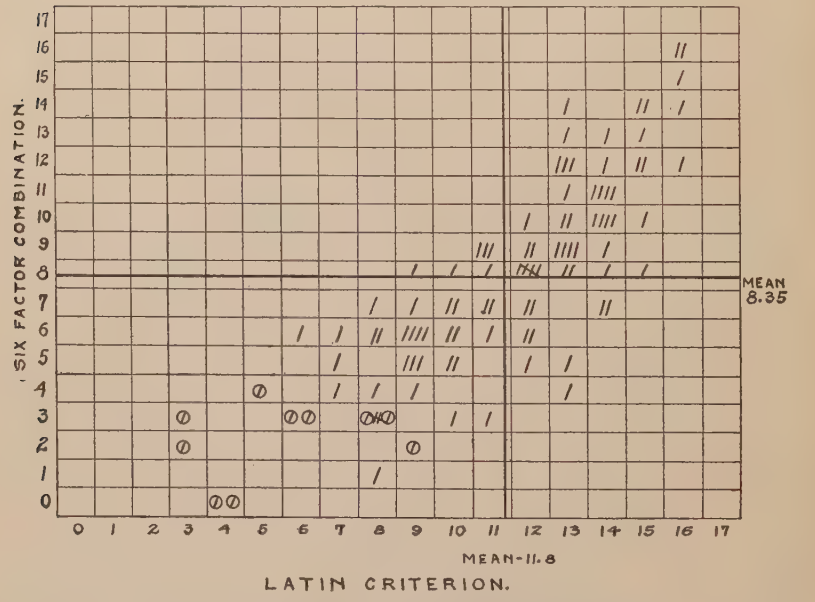

FIGURE 4. SHOWING DISTRIBUTION OF DE WITT CLINTON GROUP ON THE "SIX FACTOR COMBINATION" AND THE LATIN CRITERION

mark of these seven pupils is 75 per cent. Forty per cent of the failures and fourteen who passed are below 9. The average of these nine is 74.6 per cent.

In the case of the six factor combination, 40 per cent of the failures and one pupil who passed are below 3. The mark of this one pupil is 65 per cent. Ninety per cent of the failures and six pupils who passed are below 4. The average of these four pupils is 66.66 per cent with no one above 75 per cent. One hundred per cent of the failures and ten who passed are below 5, that is, in the lowest quartile. These ten have an average mark of 69 per cent with no one above 75 per cent. The lowest decile includes 60 per cent of the failures with only two who passed. The average mark of these two is 70 per cent.

The preceding analysis shows that the six factor combination is very much more effective than the Allen Prognosis Battery in selecting pupils on the basis of achievement. While this is true, it must be recognized that the six factor combination contains two factors not actually obtainable until the pupil is in high school: Sum of Traits, English and Mathematics. The Allen Prognosis Battery, with Age and Elementary Average also in the combination, giving correlations of .6582 for Wadleigh and .7474 for De Witt Clinton, would probably show a selective efficiency midway between the Allen Battery and the six factor combination. The relative selective ability of the various correlation coefficients, given in Table XVII, may be approximately obtained from Tables XVIII and XIX and the foregoing illustrations.

TABLE XVIII

DISTRIBUTION OF AVERAGE OF SUCCESSIVE TENTHS OF THE GROUP WHEN $r = .60$ (APPROXIMATE)

	10th	9th	8th	7th	6th	5th	4th	3rd	2nd	1st
1st tenth	.2	.9	1.8	2.9	4.6	6.6	9.7	13.7	20.4	39.2
2nd tenth	.9	2.6	4.3	6.0	8.2	10.3	13.0	15.6	18.7	20.4
3rd tenth	1.8	4.3	6.4	8.2	10.1	11.7	13.5	14.8	15.6	13.7
4th tenth	2.9	6.0	8.2	9.8	11.4	12.4	13.2	13.5	13.0	9.7
5th tenth	4.6	8.2	10.1	11.4	12.2	12.5	12.4	11.7	10.3	6.6
6th tenth	6.6	10.3	11.7	12.4	12.5	12.2	11.4	10.1	8.2	4.6
7th tenth	9.7	13.0	13.5	13.2	12.4	11.4	9.8	8.2	6.0	2.9
8th tenth	13.7	15.6	14.8	13.5	11.7	10.1	8.2	6.4	4.3	1.8
9th tenth	20.4	18.7	15.6	13.0	10.3	8.2	6.0	4.3	2.6	.9
10th tenth	39.2	20.4	13.7	9.7	6.6	4.6	2.9	1.8	.9	.2

This table was computed by Professor E. L. Thorndike and is used here with his permission.

TABLE XIX

DISTRIBUTION OF ARRAYS IN SUCCESSIVE TENTHS OF THE GROUP WHEN $r = .80$

	10th	9th	8th	7th	6th	5th	4th	3rd	2nd	1st
1st tenth			.1	.4	1.1	2.6	5.4	11.1	23.1	56.2
2nd tenth		.3	1.0	2.5	4.8	8.5	13.5	19.9	26.3	23.1
3rd tenth	.1	1.0	2.8	5.6	9.0	13.2	17.1	20.1	20.0	11.1
4th tenth	.4	2.4	5.6	9.2	12.8	15.9	17.6	17.1	13.5	5.4
5th tenth	1.1	4.8	8.9	12.8	15.5	16.6	15.9	13.2	8.6	2.6
6th tenth	2.6	8.6	13.2	15.9	16.6	15.5	12.8	8.9	4.8	1.1
7th tenth	5.4	13.5	17.1	17.6	15.9	12.8	9.2	5.6	2.4	.4
8th tenth	11.1	20.0	20.1	17.1	13.2	9.0	5.6	2.8	1.0	.1
9th tenth	23.1	26.3	19.9	13.5	8.5	4.8	2.5	1.0	.3	
10th tenth	56.2	13.1	11.1	5.4	2.6	1.1	.4	.1		

CHAPTER VI

SUMMARIZED CONCLUSIONS

I. The Briggs Analogies Tests, of all factors used in this experiment, are the best single objective measures for predicting achievement in first year Latin. Either Alpha or Beta has a consistent average correlation of .50 with the Latin criterion tests given at the end of the semester.

II. The Allen Battery of prognosis tests: Briggs Analogies Alpha and Beta; Thorndike Test of Word Knowledge A and B; Rogers Interpolation 1 and 2, predict Latin achievement for different groups, with an average correlation of .60 or above. Allen obtained a correlation of .588 for 364 pupils in the Boys High School, Brooklyn. The writer, with the Allen Battery, secured a correlation of .563 for 80 girls at Wadleigh High School, and a correlation of .667 for 103 boys at De Witt Clinton High School. By the addition of age and the average of all marks for the last year of the elementary school, to the Allen Battery combination, the correlations were raised to .658 and .747 for Wadleigh and De Witt Clinton, respectively. Allen's tests require 70 minutes of time, and the last two factors come from the school record.

III. The four predictive factors: Briggs Beta, Age, Thorndike B, Elementary Average, give in combination a correlation of .648 for Wadleigh, and .723 for De Witt Clinton. To secure data for the first and third factors requires 26 minutes of testing. The other two are items of ordinary school record. When the Latin teacher's judgment of pupils on eleven character and industry traits is added, as a fifth factor, to the above combination, the correlations become .805 and .824. To obtain this factor requires approximately an hour of the teacher's time. High school English added as a sixth factor to the Wadleigh group raises the correlation to .824. An average of high school English and mathematics added to the De Witt Clinton group raises the correlation to .840. The last factor is also an item of school record.

IV. The following seven predictive factors: Briggs Beta; Age; Thorndike B; Sewing and Cooking; Physical Training; Penmanship, Music, and Drawing; General Estimate; in combination, gave

for the Wadleigh group a correlation of .690. The marks in this combination are for the last year of the elementary school. The factors for this combination were selected solely on the basis of how much they would add, regardless of their objectivity.

V. The highest correlation coefficients for the Boys High group are below the highest for Wadleigh and De Witt Clinton. Two reasons for this are evident. First, two factors, Elementary Average and Sum of Traits, are lacking for this group. Second, Allen's original correlations were greatly reduced by the selection of 215 of his original 364 pupils still in school at the end of the third semester. The following four factors in combination: Briggs Beta, Age, Thorndike B, Average of English and Mathematics, give for this group a correlation of .656.

APPENDIX [1]

Forms of the same Latin criterion tests were given to the Wadleigh and De Witt Clinton groups at the end of the second semester. There were 60 pupils still in school and available at Wadleigh, 67 at De Witt Clinton. Tables XX and XXI show the respective results for the two groups, using the data of the six factor combination that were secured the first semester. This combination consists of: Briggs Beta, Age, Thorndike B, Elementary Average, Sum of Traits, English and Mathematics (English alone in case of Wadleigh).

Tables XX and XXI show that the correlations of the six factor

TABLE XX

SHOWING THE SIX FACTOR COMBINATION FOR THE SECOND SEMESTER WADLEIGH GROUP

	Criterion (r_{IC})	Intercorrelation						Correlation Combination ($r_{IC'}$)	Amount Added to $r_{IC'}$
		Briggs Beta	Age	Thorndike B	Elem. Average	Sum of Traits	English		
Briggs Beta	.2336		.0854	.6870	.3820	−.0082	.4885	.2336	
Age	−.0514	.0854		−.0003	−.1296	−.0303	−.1028	.2443	.0107
Thorndike B	.3063	.6870	−.0003		.3550	−.0551	.6845	.3105	.0662
Elem. Average	.3983	.3820	−.1296	.3550		.2669	.2262	.4327	.1222
Sum of Traits	.3603	−.0082	−.0303	−.0551	.2669		.1157	.5187	.0860
English	.3460	.4885	−.1028	.6845	.2262	.1157		.5400	.0213

TABLE XXI

SHOWING THE SIX FACTOR COMBINATION FOR THE SECOND SEMESTER DE WITT CLINTON GROUP

	Criterion (r_{IC})	Intercorrelation						Correlation Combination ($r_{IC'}$)	Amount Added to $r_{IC'}$
		Briggs Beta	Age	Thorndike B	Elem. Average	Sum of Traits	English and Math.		
Briggs Beta	.4404		−.2446	.2559	.1355	.1745	.4531	.4404	
Age	−.5380	−.2446		−.2690	−.0806	−.3772	−.3899	.6252	.1848
Thorndike B	.2851	.2559	−.2690		.2921	.0074	.2337	.6307	.0055
Elem. Average	.1425	.1355	−.0806	.2921		.1895	.4735	.6320	.0013
Sum of Traits	.5291	.1745	−.3772	.0074	.1895		.4515	.7106	.0786
English and Math	.6115	.4531	−.3899	.2337	.4735	.4515		.7443	.0337

[1] Tables showing complete data for this study are on file in the Teachers College Library.

combination for the second semester are .54 and .7443, respectively, for the Wadleigh and the De Witt Clinton groups. These are considerably lower than for the first semester. Selection has no doubt made the group more homogeneous, as proved to be true when Dr. Allen's original group of 364 was reduced to 215. In the second place, the criterion tests in their present form seem designed primarily for the first rather than the second semester's work. To be equally satisfactory for the second, they should be revamped to measure the specific material studied during the second semester. This was not practicable in the present experiment. It would involve the development of a new set of tests, destroy comparability, and complicate the main problem. To devise a new set of tests, based on the same technique but designed primarily for material of the second semester, is suggestive for future experiment. It would make possible a more thorough testing of the combinations developed in this study.

VITA

Orlie M. Clem was born at Benton, Illinois, July 3, 1891. He attended the public schools of Franklin County, Illinois, and was graduated from the Benton Township High School in 1910. For four years he taught in the schools of Benton and Christopher, Illinois, in the capacity of elementary teacher, elementary principal, and high school principal.

From 1914 to 1918, he was a student at the University of Illinois, receiving the A.B. degree in 1918. He enlisted in the Third Officers Training Camp, Jan., 1918, and served as a commissioned officer until December, 1918. From January to June, 1919, he taught history in the high school at Greenville, Illinois. He was superintendent of schools at Atlanta, Illinois, 1919–1920; superintendent at Colfax, Illinois, 1920–1921. He was a graduate student in the summer sessions of the University of Illinois, 1919, 1920, 1921.

He was a graduate student at Teachers College, Columbia University, from September, 1921, to August, 1923. The A.M. degree and the high school principal's diploma were received, June, 1922. He was a research scholar at Teachers College 1922–23.

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